

#2 WRF Microphysics Validation with HMT Observations: Simulations of Winter Storms Impacting the Complex Terrain of Northern California

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Quantitative Precipitation Forecasting (QPF) is one of five major activity areas associated with the Hydrometeorology Testbed (HMT). Accurate QPF is needed to develop improved hydrological forecasts for flood warning and flood control. Unfortunately, skill levels of the numerical weather prediction (NWP) models used to generate QPF are often insufficient to achieve these objectives. One of the factors that contribute to inaccurate QPF is deficient parameterizations of cloud and precipitation microphysics. In order to better understand the errors in microphysics parameterizations, it is essential to perform detailed comparisons of NWP model simulations with high-quality observations that characterize not only state parameters, winds and precipitation at the surface, but also winds and precipitation structure aloft. Through this approach, clues about deficiencies in the microphysics parameterizations can be obtained and used to inform strategies for improvement. This project is addressing the aforementioned issues by performing a physical validation of Weather Research and Forecasting (WRF) NWP model simulations with observations collected from HMT-West in northern California during 16 major precipitation events over the 2005-2006 through 2011-2012 winter seasons.

WRF model setup for the simulations involves use of the Advanced Research WRF (ARW) and Nonhydrostatic Mesoscale Model (NMM) dynamic cores and five different microphysics schemes (Ferrier, WSM3, WSM6, Thompson and Morrison). A single 4-km resolution horizontal grid centered on northern California (383 east-west by 349 north-south grid points) is employed with 60 vertical levels and a model top of 30 mb. NAM analyses are used for initial and lateral boundary conditions.

An extensive array of instrumentation has been deployed in northern California since 2005 in support of HMT-West, with field sites along the coast, in the coastal mountain, along the Central Valley and in the Sierra Nevada. The focus in this project is data collected at two different Atmospheric River Observatories (AROs), which are composed of a combination of profiling radar, GPS and surface meteorology instrumentation distributed between two different field sites in close proximity (< 100 km) to each other within a region. One of the ARO couplets to be employed is located along the coast and in the coastal mountains north of San Francisco while the other couplet is located along the Central Valley and in the Sierra Nevada east of Sacramento.

In this presentation, validation results for one of the precipitation events (14-16 February 2011) at the coastal ARO will be discussed. While the horizontal water vapor transport associated with this event is well simulated, QPF in the coastal mountains is low by as much as a factor of 3-4, especially when the observed orographic precipitation is shallow and dominated by warm rain processes. Output from the Morrison scheme provides reflectivity and Doppler vertical velocity structures that most closely resemble the observations. However, that scheme does not produce appreciably better QPF than the other schemes